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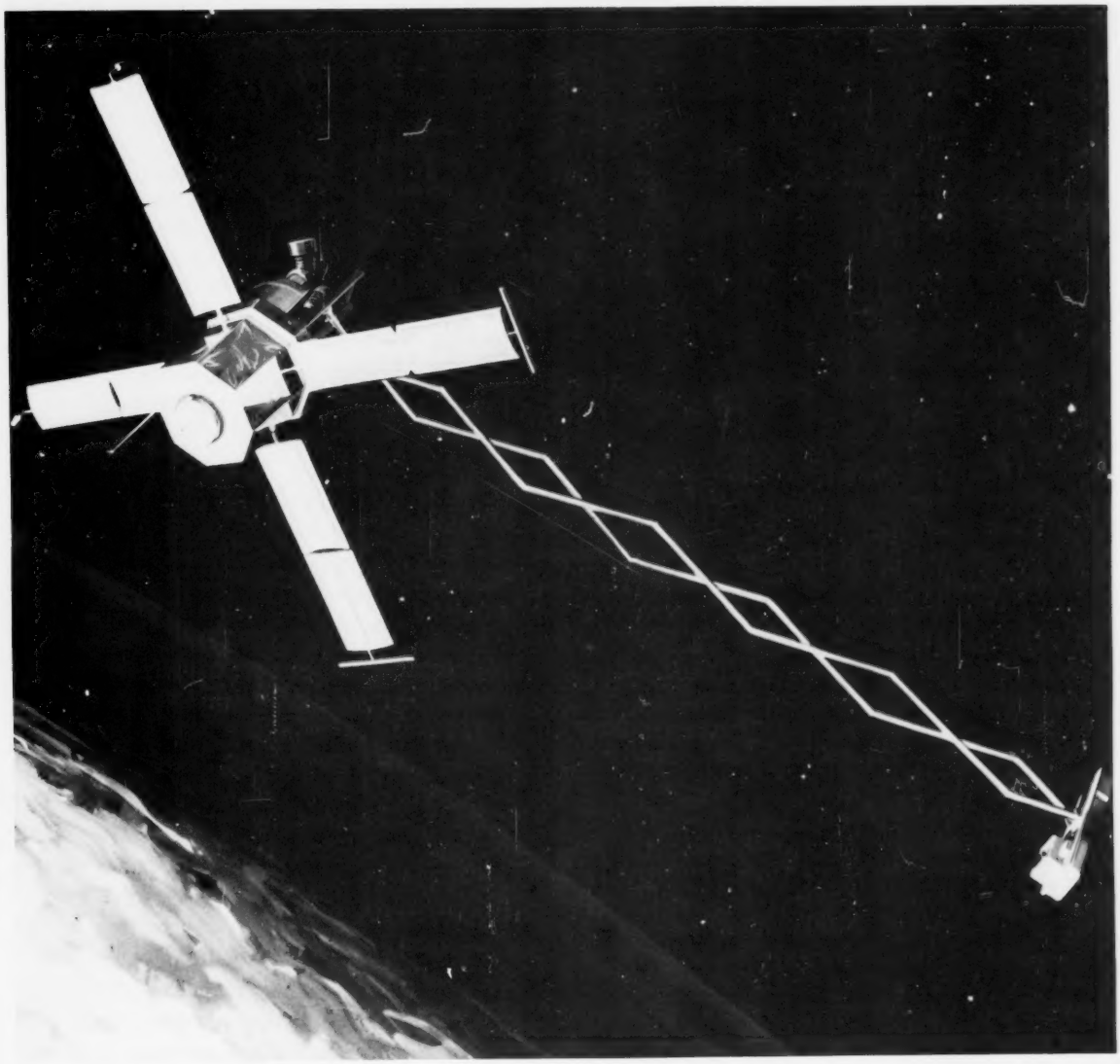

Cover

Satellite Probes Earth's Magnetic Field—One of the last spacecraft launches of the decade placed the Magsat in a sunlit (dawn to dusk) Sun-synchronous, nearly polar orbit. With a perigee of 350 kilometers and an apogee of 500 km, Magsat's low orbit will provide for successive spacecraft Earth tracks approximately 150 km apart, covering the globe completely every 10 days. An artist's concept of the orbital configuration shows the "scissors" type extendable boom holding the module which contains the precision sun sensor, dihedral mirror, scalar magnetometer and vector magnetometer. Magsat's planned minimum mission life is 120 days.

Table of Contents

Letter from Washington 3
STS Operations Office Created—More Engine Test Trouble 4
Shuttle Flights Booked Through 1984 4
KSC Host to Spacelab 2 Working Group 5
Magsat to Study Earth's Magnetic Field 6
Pegasus 2 Reentry 9
Pickering a Hall of Fame Inductee 9
Pictures Reveal New Moon of Jupiter 10
Scientists Probe Possible "Comet Dust" 10
SPAR a Milestone in Space Processing 12
Dryden Conducts Wake Vortex Tests 12
Experimental Turbofan Engine Delivered 13
Lightning May be Source of Gases 13
IUE Returning Wealth of Data 14
Missing Moon Rocks? 14
Forty Years of Jet Aviation 14
Voyager Reacquired 15
NASA Seeks Proposals for Power System 15
Scherer Receives NASA's Highest Honor 16
Personnel Changes at KSC 16
Hansbrough to Opportunity Post 17
Kudos for NASA Film 17
Contractor News 18
Patents for Inventions 19
Launches for 1979 19
Another Dividend from Air and Space 20

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Letter from Washington

Dear Colleagues:

It seems appropriate at this special time of year, when mankind's long-sought goal of "peace on earth" is brought increasingly to our attention, to remind ourselves that very much of what we do as individuals during our working days and weeks and months at NASA is helping in a variety of effective ways to move us toward that very goal.

In this final month of the seventies, every man, woman and child in every nation can look up and see Venus in the evening sky and watch Jupiter and Saturn rise later in the evening. Thanks to two Pioneer and two Voyager spacecraft, and to a lot of very fine work by NASA and contractor people, mankind's knowledge of those planets, and therefore of the solar system and our own Earth, is vastly greater than a year ago. That added knowledge, fully shared, is a present from NASA and our nation to all humanity, tending to draw together across geographical, political and ideological barriers all who look upward at the sky and wonder.

Because our Earth is an integral part of the solar system and that system a part of our galaxy and our galaxy belongs to the local group of the galaxies which comprise the universe, we must seek to understand the chemistry, physics and phenomena of the galaxy and the universe if we are to understand the place and function of Earth and man in the cosmos. In this past year, with HEAO 2, HEAO 3, the International Ultraviolet Explorer and other systems we have been able to observe and begin to map the galaxy and the universe in wave lengths not usable before, again adding hugely to the sum of human knowledge for the benefit of *all* mankind.

Similarly, with ISEE we have improved our understanding of the complex relationships between our Earth's high atmosphere and the phenomena of the Sun which warms us all; while closer to home our work in communications satellite technology helps to draw the peoples of the world together, and the data generated by our remote sensing satellites is available to all who need it to improve the human condition.

In sum, as we enjoy the holidays with those we love, we can derive additional satisfaction from the knowledge that what we do in fact conforms to the concept of the season, that our time at work is in truth, to a significant degree, "devoted to peaceful purposes for the benefit of all mankind."

Sincerely,

Robert A. Frosch

STS Operations Office Created

A new Headquarters program office has been established to be responsible for operations of the Space Transportation System, NASA Administrator Dr. Robert A. Frosch has announced.

The new office, headed by an Associate Administrator to be named soon, will have charge of Space Transportation System operations and functions including scheduling, manifesting, pricing and launch service agreements, the Spacelab program, and NASA's expendable launch vehicles, except for development of Space Shuttle upper stages. The new office will be the principal interface with all STS users.

John F. Yardley, presently NASA's Associate Administrator for Space Transportation Systems, will be Associate Administrator for Space Transportation System Acquisition. He will be responsible for the development and acquisition of the Space Transportation System, including the Space Shuttle, and its upper stages, associated ground facilities and equipment, and system improvements.

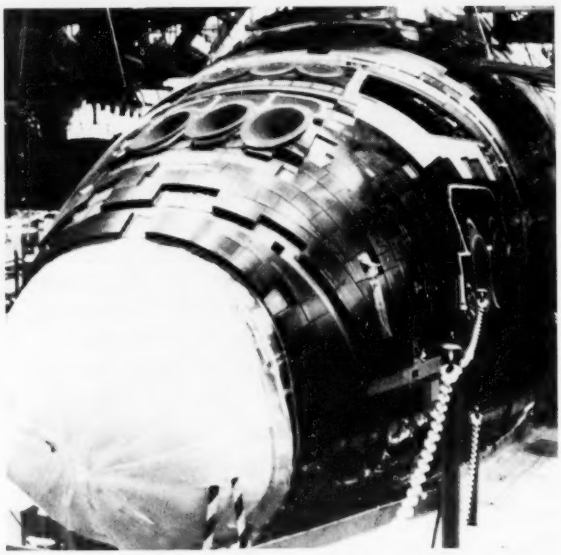
In announcing the change, Frosch said, "This organizational move streamlines our Shuttle management system by freeing John Yardley to focus his attention on getting the Shuttle system built and flying, and by centralizing our Shuttle services in a new, user-oriented organization."

L. Michael Weeks, General Electric Co. executive, was named Deputy Associate Administrator for Space Transportation Systems Acquisition, with the appointment effective Nov. 5.

In his new position, Weeks, as Deputy to Yardley, will play a key role in the development and acquisition of NASA's Space Transportation System, including the Space Shuttle, its upper stages, associated ground facilities and equipment and system improvements.

. . . And More Engine Test Trouble

On Nov. 4 a scheduled 510-second static firing of the test article of the Space Shuttle Main Propulsion System ended after nine seconds at the National Space Technology Laboratories. A sensor detected excessive pressure in a seal cavity of the high-pressure oxygen pump on No. 3 engine, bringing on automatic cutoff of firing the three-engine cluster. Another engine, No. 1, was damaged in the cutoff sequence. A detailed inspection is underway on the affected hardware and assessment of the impact on the Shuttle program schedule, if any, has yet to be made.



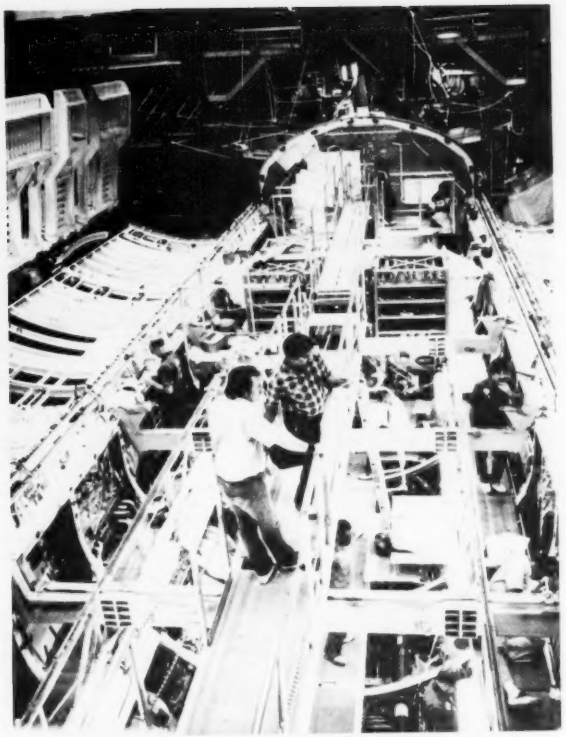
Shuttle Forward Section Reset—After months of intensive checkouts and testing, the Forward Reaction Control System of the Shuttle orbiter was recently reinstalled at the Kennedy center. The forward module was removed shortly after the orbiter Columbia's arrival at KSC and placed in the checkout cell of the Hypergolic Maintenance Facility for initial processing. During orbital flight, the forward system will steer the spacecraft, working in conjunction with two similar pods at the aft end.

Shuttle Flights Booked Through 1984

NASA has firm payload commitments for the first 37 operational Space Shuttle flights beginning in 1981. The Shuttle, therefore, is almost completely booked through early 1984.

The 47 payloads supported by the flights represent commitments by 14 government, commercial and foreign users, and range from the European Space Agency's Spacelab to weather, communication and navigation satellites. NASA payloads are expected to account for 32 percent of these payloads, the Department of Defense about 15 percent and all other users about 53 percent.

These payloads normally are assigned to flights on a first come-first served basis. However, missions that involve national security will be given priority, as well as missions with significant scientific and technological objectives or time-critical launch windows. Flights



Open Doors to Payload Berth—Engineers and technicians swarm over the Space Shuttle orbiter's aft assembly at the Kennedy center as the doors to the payload bay are opened for the first time using the onboard door operating system. With 47 payloads already commited to the Shuttle operational flights, the cargo bay will accomodate a wide range of scientific experiments.

for which NASA will be fully reimbursed also will be given preference over routine scientific and technological experiments.

A range of services are available to Shuttle users. Standard services, which are uniform for all non-government users, include a basic Shuttle launch for a one-day mission with a standard orbital altitude and inclination, three member crew and standard support services. Optional services are available at extra cost upon request. These services could include special hardware, analysis and testing, use of Kennedy Space Center facilities and services, and special orbital operations such as extra-vehicular activity and longer duration missions.

In addition to the 47 large payloads that will occupy much or all of the Shuttle's cargo bay, more than 200 organizations and individuals have reserved room for some 300 small self-contained payloads, called Getaway Specials. These universities, companies and researchers, for $3,000 to $10,000 will send their own 200-pound or less payload into orbit aboard Shuttle. The Getaway Specials must be of research and development nature.

The Shuttle's first payload, one of three preliminary payloads scheduled to fly before the Shuttle becomes operational, will ride the second orbital flight test scheduled for next year. Named OSTA 1 for NASA's Office of Space and Terrestrial Applications, the payload will consist of six Earth-sensing experiments designed to enable scientists to pinpoint natural resources and to study air pollution, lightning and ways to locate and track surface features and clouds. The payload will include also a life sciences experiment designed as a prototype for an experiment to be flown aboard the Spacelab.

The third orbital flight test will have a payload designed to allow astronauts to test the Shuttle's remote manipulator system, the mechanical arm that will be used to take payloads out of the cargo bay, position them in space and also to retrieve satellites for return to Earth. On the final flight test, an Office of Space Science payload (OSS 1), concerned with physics and astronomy experiments, will be aboard.

KSC Host to Spacelab 2 Working Group

The Spacelab 2 Investigator Working Group, consisting of about 75 scientists and engineers selected to participate in the second Spacelab mission, met at the Kennedy Space Center October 22–24.

Thirteen investigations will be flown on the Spacelab 2 mission, emphasizing astronomy, high energy astrophysics and solar physics research. Experiments will also be performed in plasma physics, botany and medicine.

Spacelab 2 is scheduled to be launched from KSC on the shuttle's 14th flight, operate in space for seven to 12 days, and land at KSC's Shuttle Landing Facility. The Investigator Working Group consists of scientists serving as principal investigators for the experiments to be conducted during the mission, and NASA mission planners and design engineers.

Of the 13 investigations planned for Spacelab 2, 11 originate in the United States and two in the United Kingdom, resulting in the involvement of 47 scientists from across the country, and 12 from the U.K. The group was chosen from more than 1,000 candidates who responded to invitations to participate in the mission.

Like the first Spacelab flight, the primary objective of this mission is to verify the performance of Spacelab systems and subsystems and to measure the environment surrounding the Space Shuttle. The secondary objective is to obtain scientific, applications and engineering data and to demonstrate the broad capability of Spacelab to perform space research.

Generally, Spacelabs consist of unpressurized frames, or pallets, for holding experiments and pressurized laboratory modules which can be arranged in several combinations within the payload bay of the orbiter. Spacelab 2 will be a pallets-only mission. It will consist of three 3-meter pallet segments, and a special structure designed to support a large cosmic-ray experiment, exposed to space in the orbiter cargo bay. Nine of the thirteen experiments are located on the three pallets, which serve as a mounting platform for the experiment instrumentation, and provide power, thermal conditioning, data and other services to the instruments. Two life sciences experiments will be carried in the orbiter's mid-deck, and one experiment involves only observations from the ground.

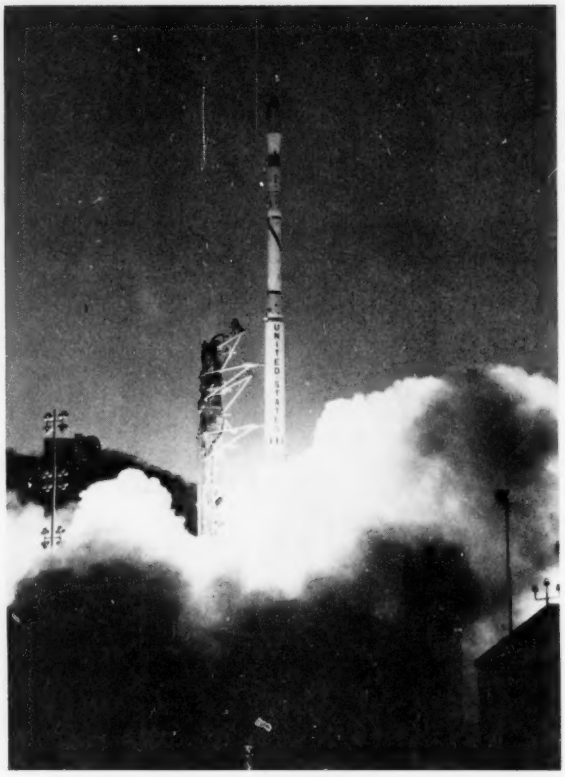
An important feature of the Spacelab 2 mission is that many of the investigations capitalize on the new capabilities of Shuttle and Spacelab. For example, the orbiter's weight-carrying capacity allows the use of a massive instrument such as the cosmic-ray experiment, along with several other large instruments. Another is an ejectable subsatellite to demonstrate the use of the shuttle's remote manipulator arm, the capability of the orbiter to launch subsatellites, and the ability of the spacecraft to maneuver about the subsatellite in space. The solar-oriented experiments will use an Instrument Pointing System which will accommodate the four experiments weighing a total of 547 kg and aim them with pin-point accuracy.

Mission scientist for Spacelab 2 is Dr. Eugene W. Urban of NASA's Marshall center. KSC's Launch Site Support Manager for the mission is Bud Wirman.

Magsat to Study Earth's Magnetic Field

The first spacecraft specifically designed to measure the near-Earth magnetic field and crustal anomalies was launched Oct. 30.

Called the Magnetic Field Satellite (Magsat), this NASA experimental spacecraft was placed in a sunlit (dawn to dusk) Sun-synchronous, nearly polar orbit with a perigee of 350 kilometers and an apogee of



500 km. This low orbit will provide for successive spacecraft Earth tracks approximately 150 km apart covering the globe completely every 10 days.

The planned minimum mission life of 120 days is expected to yield at least three complete sets of global magnetic field data which will permit averaging and statistical analysis. The launch, by a Scout launch vehicle, was from the Air Force Western Space and Missile Center, Lompoc, Calif.

In addition to a scalar magnetometer to measure the magnitude of the Earth's crustal magnetic field, Magsat will be the first spacecraft in near-Earth orbit to carry a vector magnetometer which will measure magnetic field direction as well as magnitude.

Scientists hope that Magsat data will reflect important geologic features such as composition, temperature of rock formation, remanent magnetism, and geologic structure (faulting, subsidence, etc.) on a regional scale. Such knowledge will help in the understanding of large-scale variations in the geologic and geophysical characteristics of the Earth's crust and, in turn, aid in the planning of minerals exploration.

Scientists from the United States and eight foreign countries—Australia, Brazil, Canada, France, India,

Italy, Japan and the United Kingdom—will carry on 32 investigations in six general categories: geophysics, geology, field modelling, marine studies, magnetosphere/ionosphere and core/mantle studies.

Magsat's main mission objectives are to:

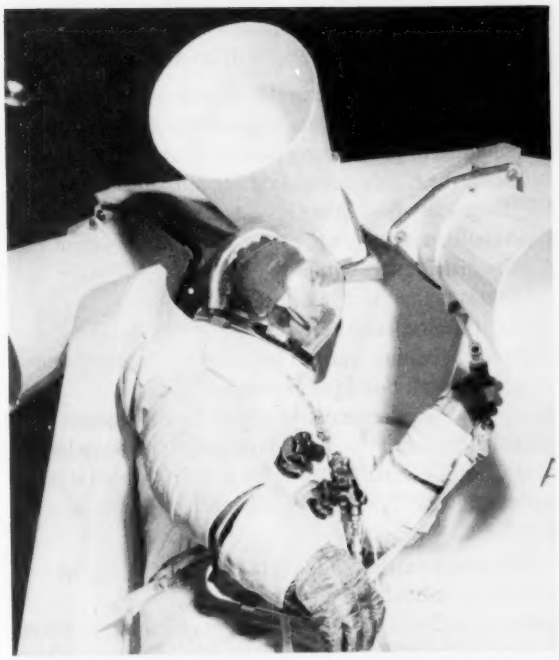
- Obtain an accurate, up-to-date quantitative description of the Earth's magnetic field;
- Provide data and a worldwide magnetic-field model suitable for U.S. Geological Survey update and refinement of world and regional magnetic charts;
- Compile a global two-dimensional (scalar and vector) crustal magnetic anomaly map. The spatial resolution goal of the anomaly map is to be better than 350 km.

The principal user of Magsat data, the Geological Survey of the Department of the Interior, has cooperated closely with NASA in setting mission objectives and will participate in the data analysis. Magsat data will be used by the Geological Survey in its publication of updated magnetic field charts and maps in 1980 for navigation and geological use.

Prior to the satellite era, magnetic data from many geographic regions were acquired over periods of years through a variety of measurement techniques. Data on many regions, such as oceanic and polar, was either sparse or nonexistent.

Satellite measurements of the geomagnetic field began with the launch of Sputnik 3 in May 1958, and have continued sporadically in the intervening years. To date, only the three Polar Orbiting Geophysical Observatories and the Orbiting Geophysical Observatories 2, 4 and 6 have provided an accurate global geomagnetic survey. These satellites operated between October 1965 and June 1971, and provided global measurements of the field magnitude over an altitude range of 400 to 1,500 km.

The satellite geomagnetic field measurements were designed to map the main geopotential field originating in the Earth's core, to determine the long-term temporal or secular variations in that field, and to investigate short-term field perturbations due to ionospheric currents. Early in the polar orbiting observatory era, it was thought to be impossible to map crustal anomalies from space. However, while analyzing data from these satellites, it was discovered that the lower altitude data contains separable fields due to anomalies in the Earth's crust, thus opening the door to a new class of investigations.



Simulated Servicing of the Telescope—Crew systems specialist Lee Weaver, wearing a pressurized astronaut suit, "services" a prototype section of NASA's Space Telescope at the Lockheed Missiles and Space facility in Sunnyvale, Cal. The mockup is of part of the Telescope's Support Systems Module, being developed by Lockheed under contract to the Marshall center. The suited-crew tests in one-gravity will help determine if the Module's design permits the efficient removal and replacement of components in space flight.

Magsat data is expected to be superior to the polar orbiting observatory data in two areas:

- Vector measurements will be used to determine the directional characteristics of anomaly regions and to resolve ambiguities in their interpretation. Knowledge of the vector components will permit identification of field variations perpendicular to the main field, and thereby restrict the range of possible models which can explain the anomaly. The vertical component will provide more precise information on the boundaries of the anomalous region.
- Lower altitude data will provide increased signal strength and resolution for detailed studies of crustal anomalies. Signal strength and resolution increase rapidly with decreasing altitude. The

magnitude of the anomalous field should increase nearly fivefold at 300 km, and the finer resolution possible will allow more detailed geological interpretations of anomalous regions.

Magsat data will be correlated with other geophysical measurements and with geological information to produce regional crustal models. For example, the highly accurate determination of the Earth's gravity field using laser tracking of satellites and satellite altimeters provides information about the density distribution within the Earth's crust.

Magsat is the third in a series of low-cost, modular design satellites, designated Applications Explorer Missions, built to be placed in special orbits to satisfy mission-unique experimental data acquisition requirements. Many of the component systems for Magsat make use of space hardware left over from the Small Astronomy Satellite which was launched in 1975. Cost of the Magsat program is $19.7 million.

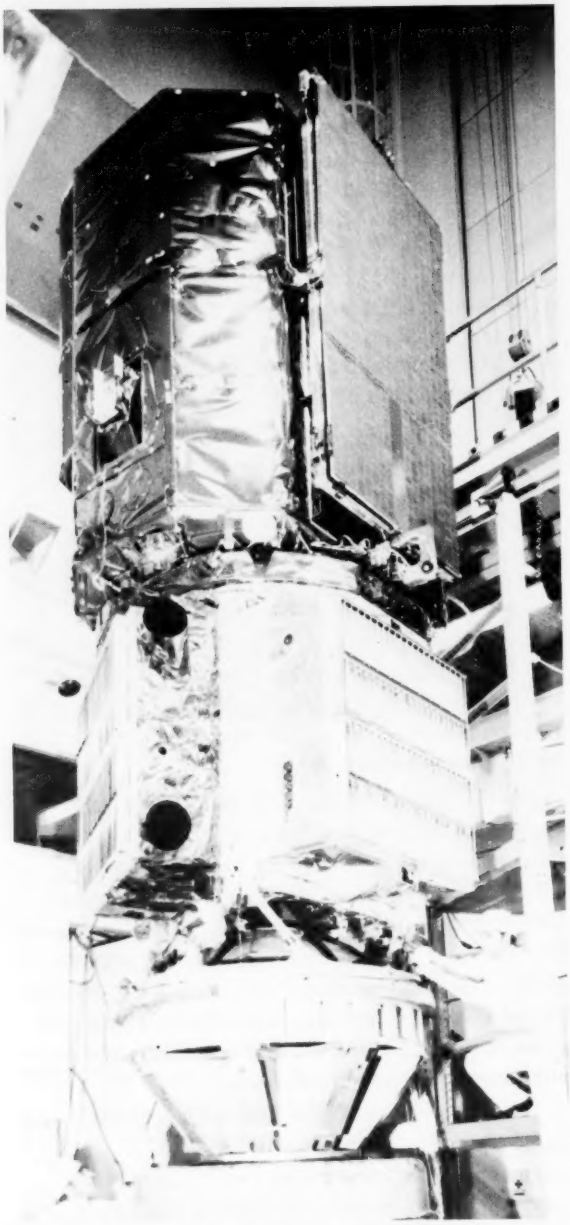
The spacecraft is made up of two parts: (1) the instrument module with the optical bench, star cameras, altitude transfer system, magnetometer boom and gimbal systems, scalar and vector magnetometers and precision Sun sensor; and (2) the base module which houses the electrical power supply, telemetry, altitude control and command data handling systems.

Overall spacecraft weight is 181 kilograms. Its solar panels provide 160 watts of power. A three axis control of ± 5 degrees enables the satellite to maintain attitude so that the magnetometer, Sun sensors, star cameras and the solar panels are properly oriented.

NASA's Goddard Space Flight Center is responsible for the design, integration and testing of the satellite and data processing. Magsat data will be stored on two onboard tape recorders and transmitted when the satellite is within reception range of the following NASA receiving stations: Merritt Island, Fla., Goldstone, Calif.; Fairbanks, Alaska; Orroral, Australia; Madrid, Spain; Goddard; Kauai, Hawaii; Quito, Ecuador; Santiago, Chile; Guam; and Ascension Island.

The spacecraft's base and instrument modules were built by the Applied Physics Laboratory, Johns Hopkins University, Laurel, Md. Langley Research Center manages the four-stage, solid-fuel Scout-G launch vehicle which places Magsat in orbit. Scout is built by the Vought Corp., Dallas, Tex.

The Magsat mission is a project of NASA's office of Space and Terrestrial Applications.

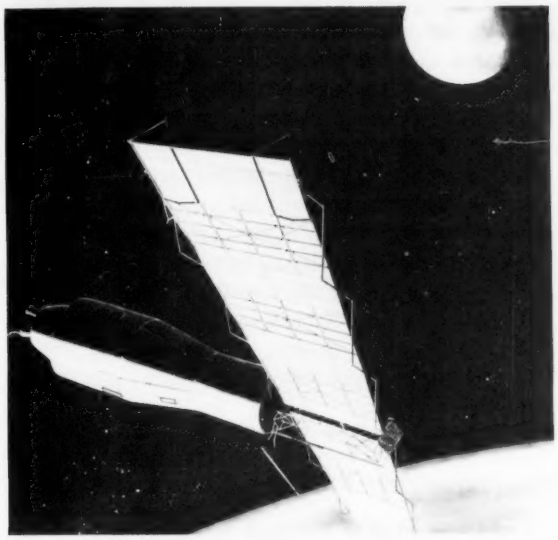


Solar Maximum Mission Testing—A Goddard center technician readies the Solar Maximum Mission (SMM) for vibration tests at Greenbelt. The SMM is mounted on the Multi-Mission spacecraft, a standard module designed to provide a common base for varied instrument packages. The paired systems will be launched into Earth orbit early in 1980 and will be retrieved from space by the Shuttle sometime in the future. The Solar Maximum Mission is equipped to study solar flares erupting on the Sun during the present period of maximum activity.

Pegasus 2 Reentry

The Pegasus 2 spacecraft assembly, launched by NASA in 1965, reentered the Earth's atmosphere on Nov. 3, according to the North American Air Defense Command. The command compiles information on satellite payloads, rocket bodies and other orbiting pieces that could survive the friction and heat of reentry and impact on Earth.

Pegasus 2, launched May 25, 1965, was used to gather micrometeoroid data for use in the design of spacecraft. It was one of three such spacecraft, all launched in 1965. Pegasus 1 reentered Sept. 17,



Pegasus Performs in Orbit—An artist's concept shows the meteoroid technology satellite in operation, one of three such spacecraft launched in 1965. Pegasus 2 reentered the Earth's atmosphere in early November, after gathering micrometeoroid date for use in the design of aircraft.

1978, over Africa and Pegasus 3 reeentered Aug. 4, 1969, over the Pacific Ocean.

The Pegasus assembly weighed about 10,430 kilograms and was 21 meters long. The spacecraft itself weighed about 1,450 kg. It was attached to the empty S-IV stage and the instrument unit of the Saturn I launch vehicle. None of the sections had any radioactive nuclear power sources or materials aboard.

It is estimated that approximately 9,705 kg of orbital hardware was destroyed by reentry heating. Such a breakup of reentering spacecraft is normal and has not, in the history of space flight, resulted in personal or property damage on Earth. No surviving pieces of Pegasus 1 or 3 were found or recovered.

Aspirations to Aerospace at JSC—This year's recruiting program for Space Shuttle astronauts has concluded but there is always the future. The neophyte is Alex Smith, age one, and his father is Murray Smith, president and publisher of Professional Pilot magazine. The Smith family was at the Johnson Space Center for a meeting of the Aviation/Space Writers Association.

Pickering a Hall of Fame Inductee

Dr. William H. Pickering, former Director of the Jet Propulsion Laboratory, was one of five aviation and space exploration leaders admitted to the International Aerospace Hall of Fame at a ceremony in San Diego October 20. The other men honored were Gen. Curtis E. LeMay, World War II bomber commander and later the leader of SAC; Lawrence B. Sperry, pioneering U.S. aviator and designer; Sir Thomas O.M. Sopwith, the famed British aircraft designer of both World Wars; and Prof. Willi Messerschmitt, foremost designer of German military aircraft.

Pickering had a key role in the development of U.S. space flight technology leading to the Apollo landings on the Moon. He also guided the nation's highly successful deep space probes to Mars, Venus and Jupiter. Since retirement from JPL, Dr. Pickering has remained active as an instructor at Caltech.

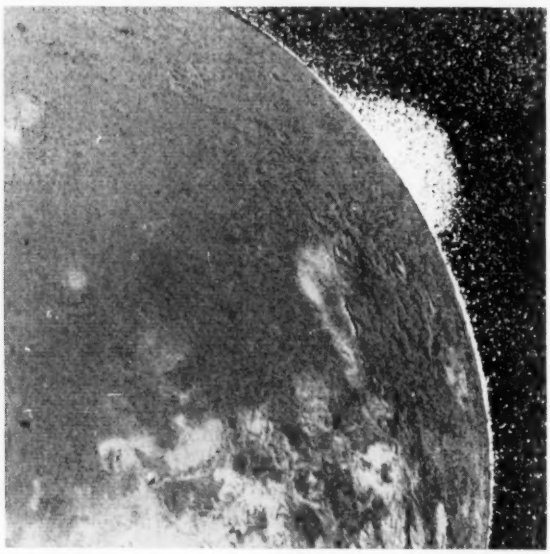
Pictures Reveal New Moon of Jupiter

A new moon of Jupiter has been discovered in pictures taken by NASA's Voyager 2 spacecraft July 8 during its excursion through the Jovian system.

While studying pictures of Jupiter's thin ring of particles taken by Voyager 2 cameras less than 24 hours prior to the spacecraft's close passage by the planet, two researchers at the California Institute of Technology—graduate student David Jewitt and scientist G. Edward Danielson, a member of the Voyager Imaging Science team—determined that a star-like object in the ring plane was a moon.

Temporarily designated 1979J1, the new satellite is the 14th known to be circling the giant planet. (Another possible moon, farther out from Jupiter and awaiting confirmation, may have been seen in Earth-based photographs several years ago by Charles T. Kowal of Caltech, discoverer of Jupiter's 13th satellite.)

The new moon adds to the list of newly-found Jovian phenomena first observed by Voyager 1 in March 1979 and expanded upon by Voyager 2 four months later. Among these firsts are the ring itself, extensive volcanic activity on the satellite Io, and tremendous bolts of lighting in Jupiter's atmosphere.



New Eruptions on Io—More violent volcanic activity was reported on Jupiter's little moon Io in late October. University of Hawaii astronomers detected a major eruption, possibly caused by super-heated molten sulfur building under the fiery moon's crust. The picture shows a special reconstruction of an erupting volcano on Io, discovered by Voyager I during its encounter with Jupiter in March.

1979J1 is the closest moon to Jupiter, orbiting the planet at the outer edge of the ring about 57,800 kilometers from the cloud tops. It is estimated to be only 30 to 40 km in diameter, smaller than seven of Jupiter's other moons but larger than six.

The satellite's orbital period is 7 hours, 8 minutes and moves in its orbit at a velocity of 30 kps. This is the fastest moving satellite in the solar system and it has the shortest orbital period.

First hint that the apparent star-trace photographed by Voyager 2 was a Jovian satellite came when Jewitt and Danielson, after an exhaustive search, found no star in the vicinity.

This led to examination of another Voyager 2 photo of higher resolution showing the same portion of the ring, the same curious object and some trails of known stars. Verification that the object was indeed a satellite of Jupiter was based on the differing angles and lengths of the star trails and the trail left by the target object. From the two pictures, an orbit was calculated independently by Jewitt and by Dr. Stephen Synnott, optical navigation engineer at the Jet Propulsion Laboratory in Pasadena, Calif., where the Voyager project is managed for NASA.

A special analysis of pictures taken four months earlier by Voyager 1 is being conducted in an effort to locate the same satellite.

Scientists Probe Possible "Comet Dust"

Tiny particles of dust that may have been shed from a passing comet have been analyzed successfully by a group of university scientists working for NASA. Their results, reported in the current issue of *Science* magazine, suggest that this unique, little-understood extraterrestrial material may contain chemical information dating back to the formation of the solar system 4.5 billion years ago.

The successful analysis of single dust particles weighing only a billionth of a gram (about one 30-billionth of an ounce) was carried out by Dr. T.M. Esat, Dr. D.A. Papanastassiou and Prof. G.J. Wasserburg, all of the California Institute of Technology, and by Prof. Donald E. Brownlee of the University of Washington.

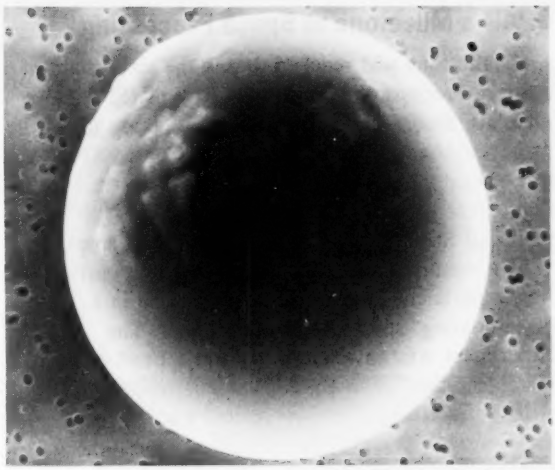
They used special instruments, originally developed to analyze Moon rocks and meteorites, that could handle, dissolve and analyze the tiny particles without loss or contamination.

"This is a real breakthrough," said Dr. Bevan M. French, discipline scientist for NASA's Planetary

Materials Program, which supported the research. "There's a tremendous amount of this extraterrestrial dust around. About half a ton of it falls to Earth every day, and much of it may have come out of comets or new kinds of fragile meteorites that don't survive to reach the ground. We could get an enormous amount of new information out of this dust—but until now, we're never been able to collect these tiny particles free of contamination or to analyze them one at a time."

The dust particles were collected by aircraft flying high above the layer of terrestrial pollution, and they appear definitely extraterrestrial. Their chemical composition, measured with an electron microscope, is similar to that of known meteorites and not to terrestrial materials. More precise analyses of the elements magnesium and calcium, which were made in a special laboratory at the California Institute of Technology, suggest that small chemical anomalies are present in some of the particles. If these anomalies show up in more particles, it will indicate that the dust still contains evidence of nuclear reactions that occurred when the solar system was formed.

The successful analysis of possible "comet dust" comes at a time when NASA is actively planning a major mission to send an unmanned spacecraft to meet Halley's Comet when that brilliant visitor makes its next regular appearance in late 1985. The spacecraft would observe Halley's as the comet flashes by and then would rendezvous with a lesser-known comet called Temple II.

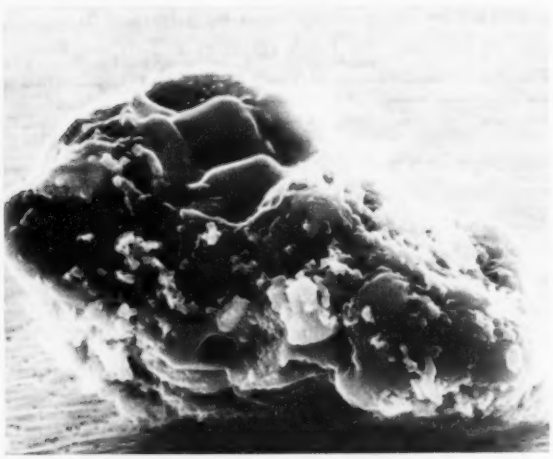


But no samples can be returned from either comet by this mission, and the dust analyses are even more important for the near future.

"Pieces of comets are probably raining down on our heads all the time, but we've never been able to analyze them before," says French. "With luck, we could find out a little about what a comet is made of before we ever see one close up."

Brownlee and his associates collected the dust particles by attaching sticky plates to a NASA-operated U-2 aircraft. Carried to an altitude of 20 kilometers well above the contaminating terrestrial particles produced by volcanic eruptions and human activities, the plates trapped only extraterrestrial dust particles that had entered the Earth's atmosphere and were drifting downward.

Three different kinds of particles, most of them about 1/100 of a millimeter across, were discovered when the plates were carefully cleaned at the University of Washington. The most common particles are fluffy, and each one is made up of as many as a million separate grains of different minerals. A second type is also fluffy, but is made up of many tiny crystals of a single mineral. The chemistry of these two groups, measured with a scanning electron microscope, is like that of chondrites, one type of meteorite that falls to Earth, but the fluffiness of the particles indicates that they were never a part of any dense meteorite. A rarer type of dust particle also was found—tiny hard spheres formed by a melting event that took place either in the Earth's atmosphere or in outer space.



Comet Dust Closeup—This tiny particle of dust is magnified about 15,000 times by a scanning electronic microscope. The dust ball, believed cast off from a passing comet, may contain chemical information dating back to the formation of the solar system itself, some 4.5 billion years ago. It weighs a billionth of a gram, about one 30-billionth of an ounce (28.35g). The dust was collected by NASA aircraft flying above the Earth's layer of terrestrial pollution and is being analyzed in a special laboratory at the California Institute of Technology.

SPAR a Milestone in Space Processing

A milestone was reached during the sixth flight of a Space Processing Applications Rocket (SPAR) in October, according to Roger Chassay, manager of the project at the Marshall Space Flight Center. SPAR 6 is the latest in a series of short-duration rocket flights that permit scientists to experiment with materials in the weightless environment of space.

The significance of this flight was that it carried the first experiment in space to process glass in a "free-floating" state without a container. The experiment was an attempt to form a bead of pure glass, leading to investigations that scientists hope will produce better quality optical glass.

To provide the high temperature required for producing glass and to achieve purity desired for the material, a new acoustic levitator furnace was developed by the Marshall center. The furnace, designed to reach temperatures up to 1575 centigrade, uses sound waves to keep the material from touching, and being contaminated by, the walls of a container during the melting and cooling process.

Acoustic levitator furnaces have been used on other SPAR flights, but never at the high temperatures needed to process glass. Chassay explained that this new equipment is definitely an advancement in the state of the art of levitators. The experiment, called "Glass Formation," was proposed by Ralph Happe of Rockwell International's Space System Group in Downey, Calif.

The experiment, along with three others on the SPAR 6 flight, was conducted during about five minutes of near weightlessness that occur during the "coast" phase of the rocket's sub-orbital trajectory.

One of the other experiments, called "Directional Solidification of Magnetic Composites," is a follow-on to similar experiments conducted on Skylab and the Apollo-Soyuz Test Project which extends the investigation of the effect of gravity on the microstructure of materials. It was proposed by Dr. David J. Larson of Grumman Aerospace, Bethpage, N.Y.

Global Ozone Research at Wallops—Scientists and engineers from five countries—Canada, Australia, India, Japan and the United States—gathered at the Wallops Flight Center in late October to compare techniques in studying the stratospheric ozone. One international group is shown preparing a Nike Orion payload carrying their sensors for solar simulation prior to launch. Twenty rocket-borne experiments were conducted from the eastern shore center, in an effort to establish instrument precision and comparability in ozone research. The session was sponsored by the World Meteorological Organization, the FAA and NASA.

Dryden Conducts Wake Vortex Tests

Flight research tests aimed at reducing the hazards of trailing wake vortices generated by large aircraft are underway at the Dryden center. Wake vortices are the normally invisible flows of turbulent air that stream in a funnel-shaped flow from the wing tips and flaps of aircraft in flight. Because vortices generated by large aircraft can be a hazard to smaller aircraft, the FAA requires a 3-to 6-mile spacing between these aircraft approaching terminals for landings.

The spacing allows time for break-up of the trailing vortices, but it also slows flight operations and contributes to passenger delays caused by airport congestion. NASA, through wind tunnel and other experimental techniques, is investigating concepts to reduce the strength of the wake vortices, which would allow closer aircraft spacing to take place and reduce delays.

One promising concept is the partial deployment of some selected wing spoilers, normally used for decreasing aerodynamic lift after landing.

The tests are being conducted by Dryden in conjunction with the Federal Aviation Administration, utilizing a Boeing 747 aircraft to generate vortices which are probed by smaller, instrumented aircraft. The flight tests will attempt to verify optimum deployment of spoiler arrangements, as suggested by wind tunnel tests, both at altitude in a simulated approach condition and in actual approaches and landings.

Experimental Turbofan Engine Delivered

The second of two experimental turbofan engines designed to demonstrate a technology of quieter operation and cleaner exhaust for future general aviation aircraft has been delivered to NASA for performance and acoustic testing.

The engine was developed and initially tested by AVCO Lycoming Division of AVCO Corp., Stratford, Conn., under direction of aeronautical engineers at NASA's Lewis Research Center.

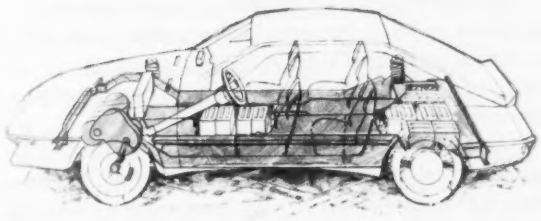
The first engine in the program, known as QCGAT, for quiet, clean, general aviation turbofan, was delivered to Lewis last winter by its designer/builder Garrett AiResearch Manufacturing Co., Phoenix, Ariz.

Preliminary results from the newly arrived AVCO engine indicate flyover noise level reduction of at least 14 decibels as compared to the quietest business jet now in service, said G. Keith Sievers, project manager at Lewis. "This lower level of noise," he said, "would produce a noise 'footprint' on the ground of less than one-tenth that produced by the quietest business jet now flying."

Noise reductions were achieved in the AVCO engine through improved acoustical design of internal engine parts—including use of sound-absorbing materials to muffle fan, compressor and turbine noise—and reduced engine exhaust velocity.

Test results from the AiResearch engine showed flyover noise reduction of approximately 10 decibels and exhaust emission reductions compared to current engines of 54 percent and 76 percent for carbon monoxide and unburned hydrocarbons, respectively. Emissions from the AVCO engine are even lower.

Overall objective of the NASA project is to demonstrate adaptability of large turbofan engine technology to smaller general aviation turbofan engines. Specific goals are to achieve major decreases in noise and exhaust emissions while maintaining or reducing fuel consumption as compared with present day general aviation turbofans.



Energy's Electric Test Vehicle—Cutaway rendering in the top picture shows the placement of batteries and other major components of the Department of Energy's Elecric Test Vehicle-I (ETV-I). The Jet Propulsion Laboratory was the Contract Technical Manager of the Near-Term Electric Vehicle program; NASA/JPL will perform extensive dynamometer and track tests. The battery system of the car was developed by Globe Union, Inc. and is packaged in a tunnel extending from behind the drive train and front suspension into the rear compartment. Overall, the ETV-I is a development of the General Electric Company and the Chrysler Corporation for DoE.

Lightning May be Source of Gases

Lightning may be a source of two environmentally significant gases in the atmosphere. Laboratory tests conducted at the Langley center showed that an electrical discharge approximately equal to that of lightning can produce trace amounts of carbon monoxide and nitrous oxide.

Although the annual global rates of production due to lightning appear to be several orders of magnitude below that due to other sources, the level of nitrous oxide became twice as great and carbon monoxide was increased 100-fold in the vicinity of the laboratory lightning bolt.

Carbon monoxide initiates a complex series of chemical reactions that are believed to lead to the production of beneficial ozone in the lower atmosphere, or troposphere, at altitudes from 10 to 15 kilometers. Lightning adds to the already large man-made sources of carbon monoxide.

IUE Returning Wealth of Data

The International Ultraviolet Explorer satellite, launched in 1978, has provided scientists from 17 countries with more than 9,000 images of astronomical objects that could not be captured by ground-based instruments.

Nearly 200 scientists have used these images in support of about 250 research programs and more than 100 scientific papers have been written about the results of the observations. The satellite is helping to answer the most basic questions in astronomy—what stars, nebulae and galaxies are and how they develop.

A cooperative effort between NASA, the United Kingdom and the 11-nation European Space Agency, the ultraviolet satellite program is managed by NASA's Goddard Space Flight Center for NASA's Office of Space Science.

The satellite, launched Jan. 26, 1978, has more than accomplished its announced objectives. The primary goals were to obtain high-resolution ultraviolet observations of astronomically bright stars, planets, stellar and planetary atmospheres, and to gather lower resolution observations of fainter, more distant objects such as quasars, Seyfert galaxies, pulsars, X-ray sources and other cosmic phenomenon.

The satellite is in a geosynchronous orbit—that is, it stays nearly stationary over a point on the equator, which enables astronomers to interact with the satellite much as they would with a ground-based telescope.

NASA Spinoff Used In-House—George Duve, a dynamic loads engineer in the Systems Dynamics Laboratory at the Marshall center, is shown reading his daily complement of technical reports. He is blind. Using a device called the Optacon, Duve is passing a mini-camera over the printed page with his right hand; with his left, he is sensing a vibrating image of the letters. The highly productive engineer is relying on a system that originated in research performed at Stanford Research Institute under NASA sponsorship.

Missing Moon Rocks?

Following recent press accounts that "substantial" Moon rock material brought back by the Apollo astronauts may be missing, NASA's Offices of Inspector General and Space Science issued a response in mid-October. This is the NASA statement:

The allegations of shortages are contained in a report of a recent audit of the lunar materials facility at Johnson Space Center conducted by the Southwest Regional Office of the NASA Office of Inspector General. Center management officials contend that the report findings are not substantiated by the facts and that there is no evidence that lunar material is indeed missing.

A check of lunar samples conducted in 1972 showed that some discrepancies existed between the weight of lunar material on hand at that time and the amount believed brought back from the Apollo 11, 12, 14 and 15 missions. The discrepancies were attributed to faulty bookkeeping prior to 1972. As a result, NASA officials say they cannot be certain whether lunar material is missing or was never brought back from the Moon in the first place.

All lunar material known to exist in 1972 is accounted for by NASA. More than half of the total of 377 kg (838 lbs.) of all lunar material returned to Earth came from the Apollo 16 and 17 missions.

NASA's new Inspector General, Eldon D. Taylor, received this report and the response by Center management shortly after his arrival on August 1, 1979. He immediately transmitted the audit report to Administrator Frosch for his information and initiated two independent investigations of the audit procedures and documentation to determine if the work was done in accordance with professional audit standards.

Forty Years of Jet Aviation

Pioneers of the jet age met for the first time at a day-long symposium on Oct. 26 at the Smithsonian's National Air and Space Museum. The symposium marked 40 years of jet aviation. Participants included: Brigadier General Charles "Chuck" Yeager, the first man to fly faster than the speed of sound; Air Commodore Sir Frank Whittle, first to successfully operate a turbojet engine; Hans J. P. von Ohain, developer of the engine for the first jet aircraft; Najeeb E. Halaby, former head of the Federal

Aviation Administration and Pan American World Airways; and John E. Steiner, "father of the Boeing 727."

Forty years ago, the first aircraft powered by the jet thrust of a gas turbine engine, the Heinkel He. 178, lifted off the ground at Marienehe Airfield in Germany. That historic flight ushered in a new era—the jet age. Each speaker at the symposium played a significant role in the development, production and expansion of jet aviation.

Included in the collection of the National Air and Space Museum are the Bell XS-1 ("Glamorous Glennis"), the plane in which Yeager flew faster than the speed of sound; the Messerschmitt Me 262, the first operational jet fighter; and the Bell XP-59A, the first American turbojet airplane to fly.

Voyager Reacquired:

Signals from NASA's Voyager 1 spacecraft were reacquired at about 11 p.m. EDT, Oct. 16 after having been lost temporarily. Mission officials at the Jet Propulsion Laboratory, which manages the Voyager project, commanded the spacecraft that night into a roll or scanning mode designed to search for the star Canopus. The spacecraft is normally locked on Canopus to keep its antenna properly oriented so that signals can be transmitted back to Earth. The maneuver was successful.

Communications with Voyager had been lost after the spacecraft failed to reacquire the target star Canopus at the conclusion of a 20-hour science maneuver. Instead, it locked onto another bright source, a pair of dim stars some 60 degrees away from Canopus.

After the spacecraft was returned to its proper orientation, its high-gain antenna again was used to send normal transmissions, and Voyager is functioning normally in its planned cruise to Saturn.

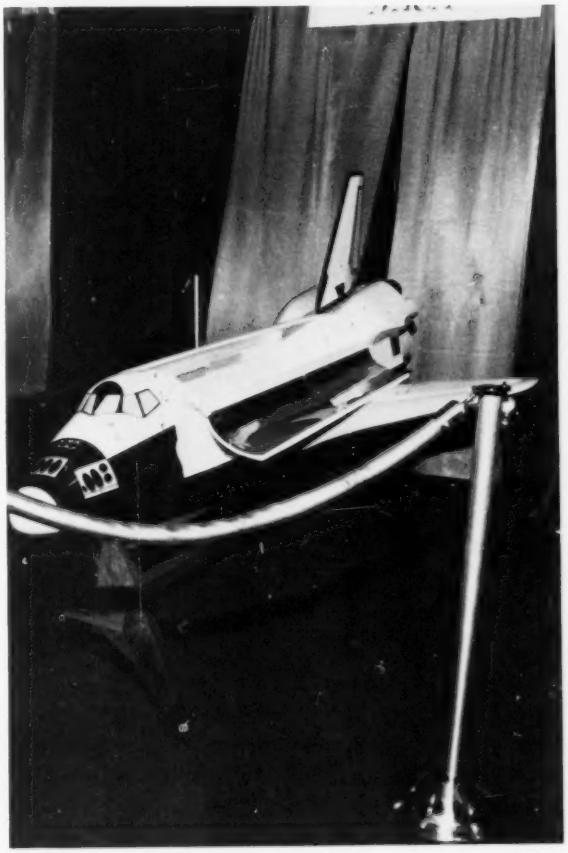
NASA Seeks Proposals for Power System

NASA has asked industry for proposals on a study to define the concept and prepare a preliminary design for a 25 Kilowatt Power System to provide supplemental solar power for long-duration Space Shuttle missions and support to free-flying payloads.

The Request for Proposals, released Oct. 5 by the Marshall Space Flight Center, offers two or more parallel contracts at a fixed price for each of $1,000,000. Firms awarded the contracts will have 12 months to complete the studies.

Results of these parallel studies should lead to the beginning of the development phase, no earlier than in 1982. The Marshall center was assigned responsibility for definition and development of the new power system in March of this year.

Luther E. Powell, project manager at Marshall, said, "We see this power system as the embryo for future large systems in space, such as future service platforms and other unmanned large space structures."



The Orbiter on Exhibit—The gleaming replica of the Space Shuttle vehicle, in a lighted display behind ropes, is one of three now traveling the country; four others are on permanent exhibition at NASA centers. The model, 2.1 meters long, and smaller versions are shown at over 120 events a year, such as the October annual meeting of the Air Traffic Control Association in Atlantic City.

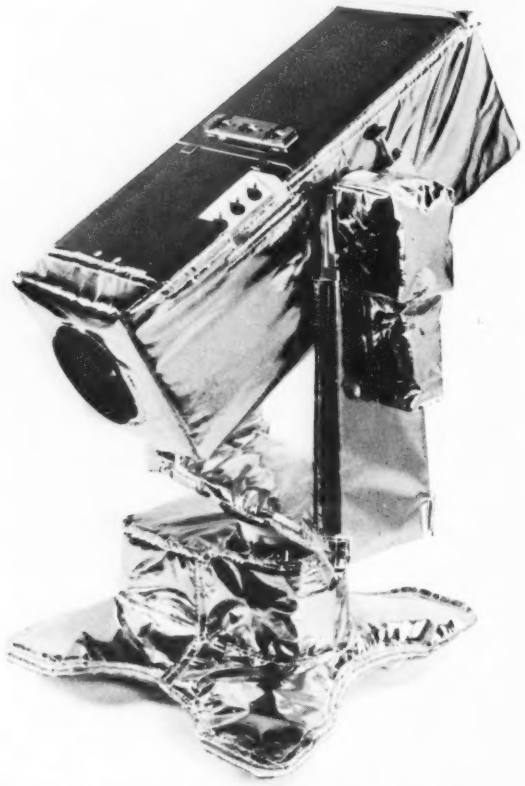
Scherer Receives NASA's Highest Honor

Dr. Lee R. Scherer, retiring Associate Administrator for External Relations at NASA Headquarters and former director of the Kennedy Space Center, has been awarded NASA's highest honor—the Distinguished Service Medal. Dr. Scherer received the award from NASA Administrator Dr. Robert Frosch during an informal ceremony at NASA Headquarters.

The award was made "in recognition of outstanding contributions to the United States and the National Aeronautics and Space Administration while serving as the Director of the John F. Kennedy Space Center.

"Under his distinguished leadership, KSC launched the Apollo/Soyuz Test Project mission, converted the checkout and launch facilities from the Apollo configuration to those required for the Shuttle program, and successfully launched 62 vehicles in 66 attempts."

The Distinguished Service Medal is the most recent of the long list of honors earned by Scherer during his NASA career. It also marks the second time he has received NASA's highest award.



"Eyes" for the Shuttle—This 16-pound closed circuit TV camera, enclosed in an insulating layer of gold foil, will be part of the Space Shuttle communications system. Placed in various parts of the orbiter, the cameras will help the astronauts handle payloads and deploy and retrieve satellites in space. RCA Astro-Electronics, of Princeton, N.J., is under contract to the Johnson center for 50 cameras for some 500 Shuttle flights planned in the next decade.

Personnel Changes at KSC

George F. Page recently was appointed Director of Shuttle Operations at the Kennedy Space Center, succeeding the retiring Dr. Walter J. Kapryan, whose distinguished career with NASA spanned nearly 32 years. Page was previously director of cargo operations at KSC. Since joining NASA in 1963 as spacecraft test conductor on the Gemini program, he has served as chief spacecraft test conductor for both Gemini and Apollo launch operations; chief of the spacecraft operations division for Apollo, Skylab and ASTP launch operations.

Page's professional experience before joining NASA included five years as launch operations engineer with General Dynamics Corporation and six years as a flight test engineer with Westinghouse Electric Corp.

Kapryan's first assignment with NASA was at the Langley Research Center in Virginia. He joined the center in September 1947 when Langley was headquarters for the National Advisory Committee for Aeronautics and became a member of the NASA space task group in March 1959. Shortly thereafter, Dr. Kapryan was appointed project engineer for the Mercury Redstone I spacecraft and traveled with the vehicle to the Cape Canaveral area in 1960. He later had a key role in the Gemini program office and established and headed the MSC Gemini program office at KSC.

Dr. Kapryan participated in the preparation and

countdown of all manned Gemini flights and all Apollo, Saturn IB and Saturn V missions.

Before he assumed the position of Director of Shuttle Operations in September 1969, Kapryan held the position of Deputy Director of Launch Operations. Previously, he was assistant Apollo spacecraft program manager at KSC, representing the Manned Spacecraft Center, assuring close coordination between the two centers in spacecraft positions.

A graduate of Wayne State University in Detroit, he was awarded an Honorary Doctorate of Science by Florida Institute of Technology in August 1973, and has received many NASA awards and honors.

As Director of Shuttle Operations, Page is responsible for the management and technical direction of preflight operations and integration test, checkout and launch of the Space Shuttle.

Page was born in Pittsburgh, Pa., and attended school in Harrisburg. After service in the Army Air Corps during World War II, he enrolled at Pennsylvania State University where he earned a B.S. degree in Aeronautical Engineering in 1952.

Hansbrough to Opportunity Post

A veteran manager at Langley Research Center, Andrew J. Hansbrough, has been named head of the center's Office of Equal Opportunity Programs. Hansbrough has been at Langley since 1964 and has served as a budget analyst; head, R&D Programs Group; head, Institutional Programs Group; and assistant to the chief and assistant chief, Management Support Division.

From December 1978 to March 1979, Hansbrough was detailed to the Office of Equal Opportunity Programs at NASA Headquarters.

Hansbrough received a bachelor of science degree in business administration from Virginia Polytechnic Institute and State University in 1961 and a master of science degree in management engineering from George Washington University in 1972.

Kudos for NASA Film

The NASA motion picture "Planet Mars", produced at Headquarters, was selected Best Film of the 1979 Midcon Film Theatre of Los Angeles. The Midcon Electronic Show and Convention placed the film of exhibition at the O'Hare Exposition Center in Los Angeles November 6–8. "Planet Mars" has been distributed to all NASA centers for public showing.

Space Style a la Soviet—The topless American is Carter Alexander, formerly of JSC's Physiology Lab, and his sci-fi plus fours are worn by Soviet cosmonauts during reentry. Alexander recently returned from a biomedical working group session in the USSR, where he acquired the lower body negative pressure garment, called a "chibis."

Contractor News

Defense and Space Systems Group of TRW, Inc., of One Space Park, Redondo Beach, Cal., has been awarded a $14.8 million contract to build measurement devices for the Earth Radiation Budget Experiment (ERBE) program, managed by the Langley Research Center. The ERBE program, operated by NASA in cooperation with the National Oceanographic and Atmospheric Administration, will involve three satellites and one will be launched from the Space Shuttle orbiter.

Pan American World Airways, Inc., Aerospace Service Division, has received a modification to a contract with the National Space Technology Laboratories for support services for facility operations at NSTL. Estimated cost of the contract extension is $15 million. Pan Am will be required to support on-site NASA programs in launch vehicle and rocket engine static testing and certification, with all work performed at NSTL, Hancock County, Miss.

Kentron International, Inc., of Dallas, Tex., has been selected for negotiation of a contract with the Marshall Space Flight Center to provide institutional support services to the center in the areas of telecommunications, documentation, graphic arts, models and exhibits. The cost and fee for the contract is expected to be in excess of $3 million for the first year.

International Business Machines, of Bethesda, Md., has won a $7 million contract with the Lewis Research Center to supply a large scale computer system to its Research Analysis Center, scheduled for completion in 1980. The contractor is to supply off-the-shelf equipment, including hardware, software and support maintenance, with installation done on site at Lewis.

Thiokol Corporation, Wasatch Division, of Brigham City, Ut., has been awarded a $1.92 million modification of the facilities contract with NASA for construction and modification of solid rocket motor production facilities to support regular flights of the Space Shuttle. Facilities involved include an additional final assembly area; a storage addition for insulated and lined casting segments; a separate reclamation area for used nozzle components; expansion of environmentally controlled nozzle fabrication and assembly area; and a quality control laboratory dedicated to solid rocket motors. The Marshall Space Flight Center is responsible for development and production of the Solid Rocket Boosters for Shuttle flights. Thiokol is the prime contractor for the Boosters.

Allan Aircraft Supply Company, of 11643 Vanowen Street, North Hollywood, Cal., has agreed on a requirements type contract with the Kennedy Space Center for up to $1 million plus in steel procurement. The contract is for various quantities of 196 line items of stainless steel, flared tube pressure fittings (KC type) as stock replenishment items for use in ground support equipment for the Space Shuttle program.

Denver and Audience of One—Singer John Denver hears the reaction after rendering "happy birthday" to Astronaut Bob Crippen over the loop at JSC. Crippen turned 42 while training in the simulator. Denver, shown with astronaut Joe Engle, was at the center to film a television special on manned flight that will air next year.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Peter F. MacDoran, Caltech JPL, Pasadena, Cal.	System For Near Real-Time Crustal Deformation Monitoring	4,170,776	NRO/JPL
Robert Miserentino, Bruce Flagge LARC, Hampton, Va.	Displacement Probes With Self-Contained Exciting Medium	4,171,645	LARC
Warner L. Stewart, Ambrose Ginsburg Melvin J. Hartmann LERC, Cleveland, O.	Supercharged Topping Rocket Propellant Feed System	4,171,615	
Michael K. Gauthier, Alan G. Stanley, Caltech JPL, Pasadena, Cal.	Method For Analyzing Radiation Sensitivity Of Integrated Circuits	4,172,228	NRO/JPL
Marshall F. Humphrey, Kenneth R. French, Ronald D. Howe, Caltech JPL, Pasadena, Cal.	Ozonation Of Cooling Tower Waters	4,172,786	NRO/JPL
Walter M. Ingle, Robert E. Chaney, Stephen W. Thompson, Motorola, Inc., Phoenix, Ariz.	A Method Of Purifying Metallurgical Grade Silicon Employing Reduced Pressure Atmosphere Control	4,172,883	NRO/JPL
Gordon A. Wiker, Wolfgang A. Mann Caltech, JPL, Pasadena, Cal.	Compact Artificial Hand	4,149,278	NRO/JPL

Launches for 1979

Name	Launch Date	Vehicle	Range	Mission Remarks
SCATHA	Jan. 30	Delta	ETR	DoD R&D. Spacecraft charging at high altitude Reimbursable.
SAGE-A	Feb. 18	Scout	WFC	NASA applications satellite. Stratospheric aerosol and gas experiment.
FLTSATCOM-B	May 3	Atlas Centaur	ETR	DoD Navy communication satellite. Reimbursable.
NOAA-A	June 27	Atlas-F	WTR	NOAA weather satellite. Reimbursable.
UK-6	June 2	Scout	WFC	UK scientific satellite. Reimbursable.
Westar-C, C/U	Aug. 9	Delta	ETR	Western Union communications satellite. Reimbursable.
HEAO-C	Sept. 20	Atlas Centaur	ETR	Third high energy astronomical observatory to study highly energetic radiation from space.
MAGSAT-A	October 30	Scout	WTR	NASA applications satellite to study magnetic field.
RCA-C	December 6	Delta	ETR	Domestic communications satellite. Reimbursable.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Add Water-Easy Meal

The lady is sitting down to a nutritious, easily-prepared meal similar to those consumed by Apollo astronauts. The appetizing dishes were created simply by adding water to the contents of a Mountain House* Easy Meal package of freeze dried food.

The Easy Meal line is produced by Oregon Freeze Dry Foods, Inc., Albany, Oregon, a pioneer in freeze drying technology and a company long associated with NASA developing suitable preparations for use on manned spacecraft. Designed to provide nutritionally balanced, attractive hot meals for senior adults, Easy Meal is an offshoot of a 1975–77 demonstration project managed by Johnson Space Center and called Meal System for the Elderly. The project sought ways to help the estimated 3.5 million elderly Americans who are unable to take advantage of existing meal programs. Such services are provided by federal, state and local agencies, but they are not available to many who live in rural areas, or others who are handicapped, temporarily ill or homebound for other reasons.

Oregon Freeze Dry Foods was a participant in that multi-agency cooperative project. With its Easy assortment of convenience foods, the company is making commercially available meal packages similar to those distributed in the Meal System for the Elderly programs.

In the freeze drying process, water is extracted for freshly-cooked foods by dehydration at very low temperatures, as low as 50 degrees below zero. Flavor is locked in by packaging the dried food in pouches which block out moisture and oxygen, the principal causes of food deterioration; thus the food can be stored for long periods without refrigeration. Meals are reconstituted by adding hot or cold water, depending on the type of food, and they are table ready in five to 10 minutes. Oregon Freeze Dry Foods offers five different meal packages and plans to expand the line.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

For the benefit of all . . .

NASA

National Aeronautics and Space Administration

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